HYDROGEOLOGY AND LAND SUBSIDENCE, ANTELOPE VALLEY, CALIFORNIA

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The Antelope Valley lies in the western Mojave Desert of southern California, about 60 mi north of Los Angeles (fig. 1) The Antelope Valley is a closed topographic basin that covers about 2,200 mi^2, and has its lowest point in the Rogers and Rosamond Dry Lakes area. The valley is bounded on the southwest by the San Gabriel Mountains and the San Andreas Fault zone and on the northwest by the Tehachapi Mountains and Garlock Fault zone. The valley overlies three structural basins; the West Antelope, the East Antelope, and Kramer, which have been filled with as much as 10,000 ft of Tertiary and Quaternary sediments (Mabey, 1960). These sediments consist of a series of unconsolidated alluvial deposits interbedded with a thick layer of lacustrine deposits. Near the southern limit of the valley these lacustrine deposits are buried beneath as much as 800 ft of alluvium, but, to the north, near the southern end of Rogers Lake the lacustrine deposits are exposed at land surface. Borehole geophysical logs indicate that the alluvial deposits contain a high percentage of thin bedded, fine-grained silt and clay material (see Ward and others abstract for additional information on the geology of the Antelope Valley).

The aquifer system in the Antelope Valley consists of two alluvial aquifers known as the principal aquifer and the deep aquifer. The principal aquifer occurs in the Lancaster ground-water subbasin and overlies the lacustrine deposits extending over most of the valley south and west of Rogers Lake. The principal aquifer is the major source of ground water pumped in Antelope Valley. The deep alluvial aquifer underlies the lacustrine beds and extends to the north beneath Rogers Dry Lake and beyond. The deep aquifer is the major source of ground water pumped at Edwards Air Force Base (Londquist and others, 1993).

Ground water in the Antelope Valley area originates primarily from the infiltration of surface-water runoff from the San Gabriel and Tehachapi Mountains. Estimates of the average annual recharge to the aquifer system range from about 40,000 to 81,000 acre-ft (Durbin, 1978, and Wright, 1924). Ground-water use for irrigation in the valley began in the early 1900’s and peaked in the 1950’s. Estimates of the peak annual pumpage range from about 280,000 to 480,000 acre-ft (Snyder, 1955; California State Water Resources Control Board, 1974). After this peak period, ground-water use in the valley began to decline because of declining water levels, increasing energy costs, and the availability of imported water. The estimated annual ground-water pumpage in 1988 was about 62,000 acre-ft (Zettlemoyer, 1990).

The estimated ground-water pumpage from the Antelope Valley has exceeded the estimated annual recharge almost every year since the early 1920’s. This imbalance is reflected in the declining aquifer hydraulic heads over most of the valley. In some areas there have been declines of more than 100 ft since the early 1950’s, and indications are that declines before this period may have been as great or greater.

Both of the major elements necessary for land subsidence exist in the Antelope Valley: thick unconsolidated sections of sedimentary material that contain high percentages of fine-grained material and large hydraulic-head declines. Land subsidence was first reported in the Antelope Valley in the 1950’s (Lewis and Miller, 1968) and by 1967 there had been as much as 2 ft of subsidence over an area of about 200 mi^2. Between 1961 and 1991 there was as much as 4 ft of subsidence in the City of Lancaster and more than 3 ft near the southern end of Rogers Lake (Blodgett and Williams, 1992; see Blodgett abstract for additional information on land-surface deformation near Rogers Lake).

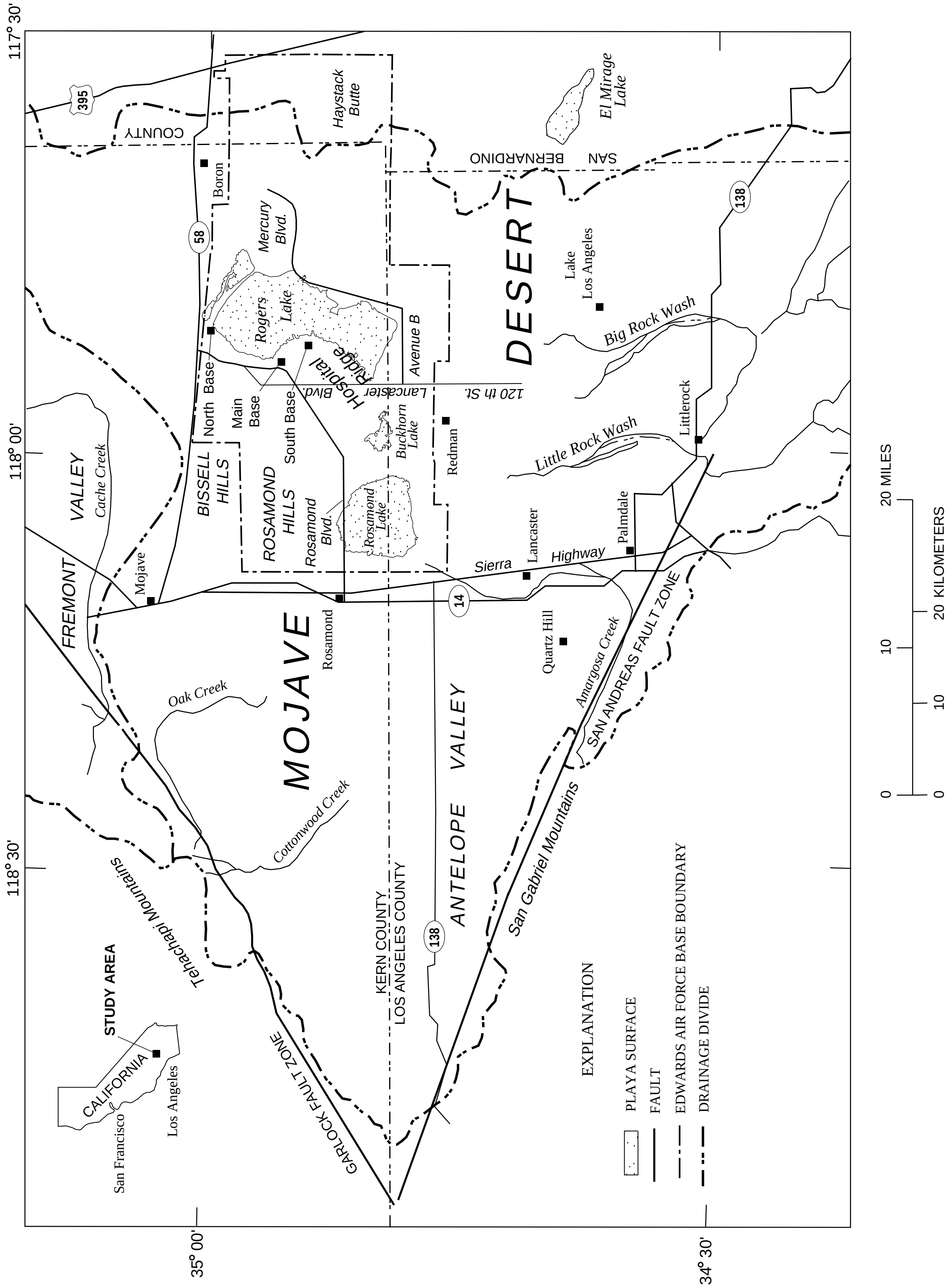

Figure 1. Location of study area.